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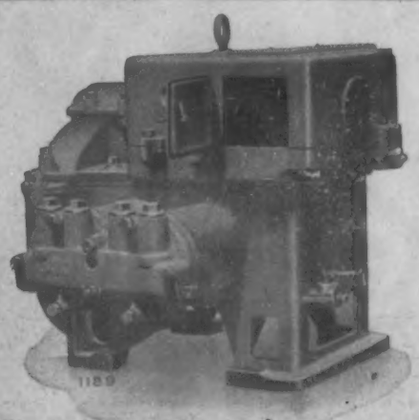

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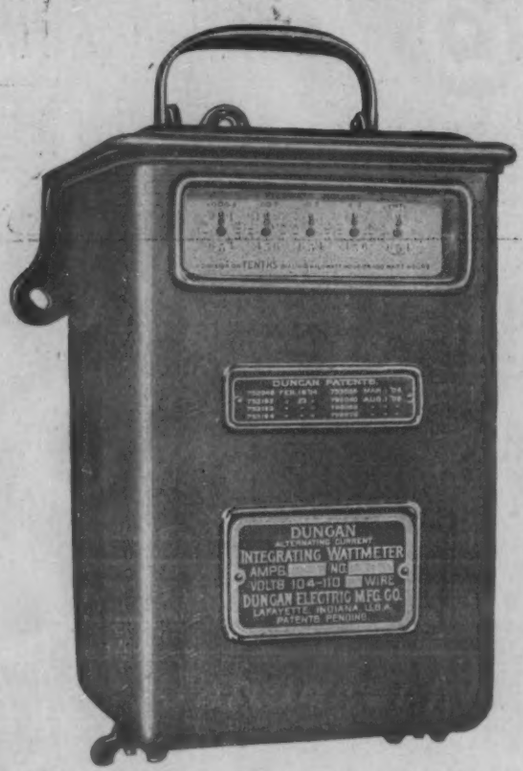

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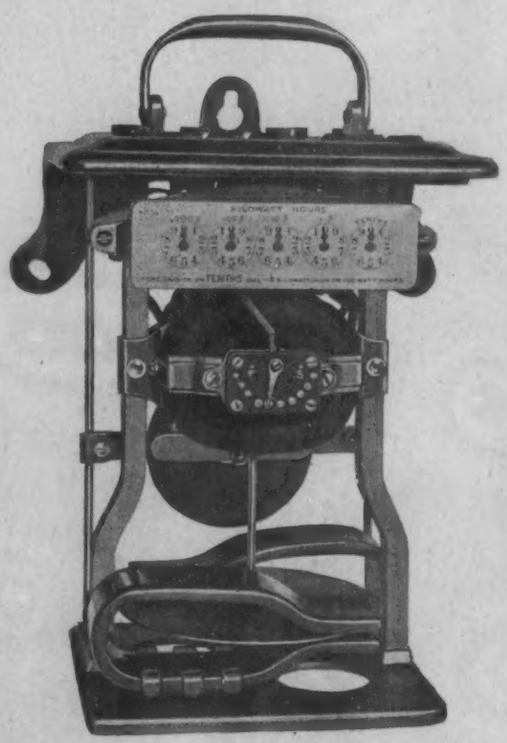

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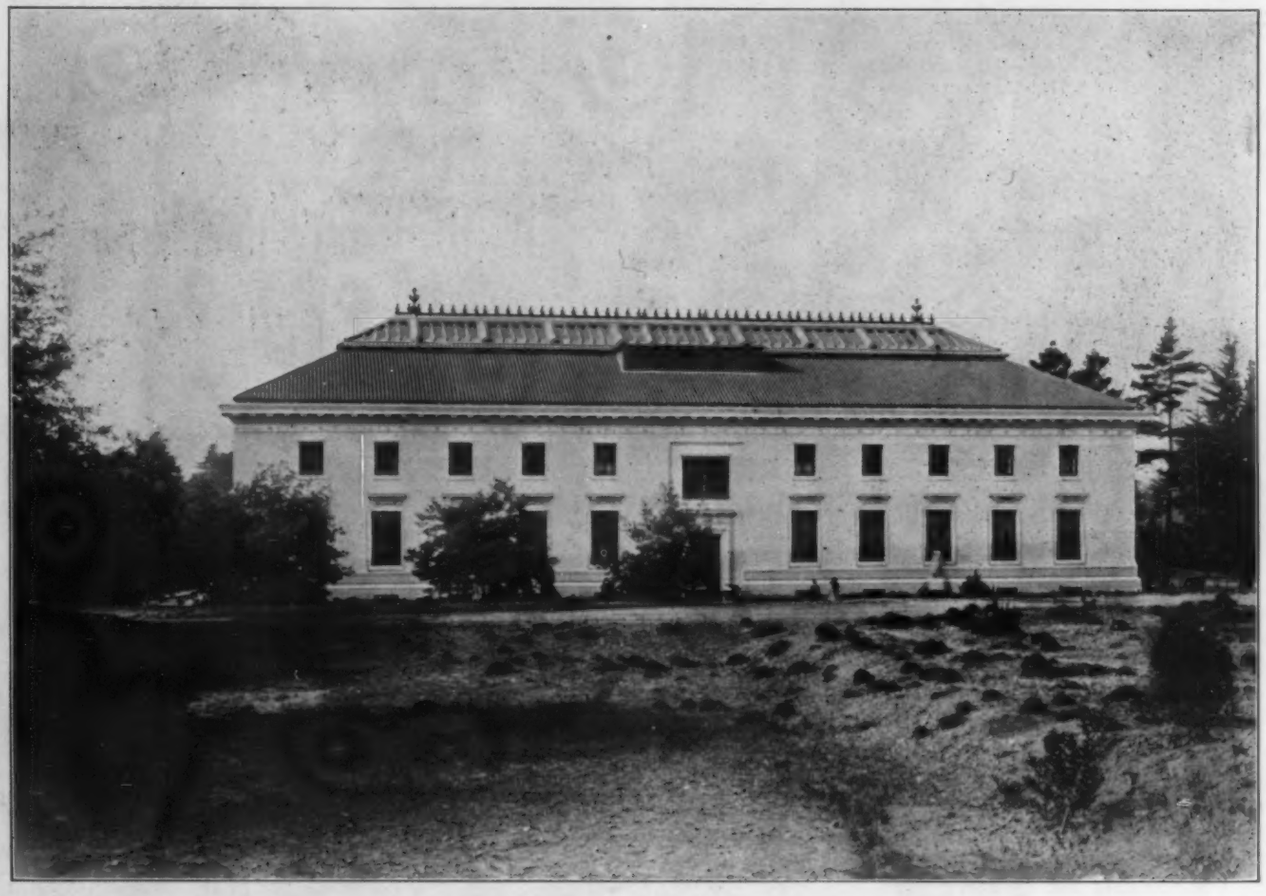
The Electric Light, Power and Heating System of the University of California.

The University Campus at Berkeley, with its numerous buildings and a transient day population of about four thousand people, is in many respects not unlike the down-town district of a large city. The problem of adequately providing heat, light and ventilation to the many auditoriums and lecture halls, the private offices, the experimental, testing and students' laboratories, and the gymnasium, is an exceedingly complex one on account of the widely different character of the service required.



CALIFORNIA HALL—THE ADMINISTRATION BUILDING.G

About three years ago the Board of Regents of the University took definite steps toward securing the installation of a heating system which would more satisfactorily, as well as more economically, keep the various buildings supplied with warm and pure air. At the same time contracts were let for the equipment of a power plant to provide the large amount of electrical energy required for lighting and power purposes. The University of California is just now in a period of rapid growth, and all improvements of a permanent nature must be designed with strict regard to the plans of the "Greater University."

The Heating System.

Some idea of the magnitude of the heating system being installed may be obtained from the fact that when the work

already contracted for is completed, about two miles of piping will have been laid. Of this about three-quarters is already under ground, and carrying steam to several buildings.

Two common systems of heating are employed. In the Harmon Gymnasium, the Hearst Memorial Mining Building and California Hall—the last two named being magnificent white granite buildings of the most modern construction—the forced-blast system of heating and ventilating is used. In this system a motor-driven fan or blower, usually located in the basement, draws in cold, pure air from the outside, and causes it to pass over and through coils through which steam is circulating. The air becomes warmed and is forced through distributing ducts into the various rooms through registers located in the upper part of the walls. The impure air, which contains carbon dioxide and other undesirable gases, is forced out through openings placed in the lower part of the walls of each room and delivered through vents to the outside.

inch. A high-pressure line is being laid at present to the Hearst Memorial Mining Building, with a branch line to the Mechanical and Electrical Engineer Building, situated directly west of it. High-pressure steam will be used in the former building to drive air compressors and for experimental purposes. In the Mechanical and Electrical Engineering Building is the present electric power plant of the University, and the object of inter-connecting the two buildings with the central power plant by a high-pressure steam line, is to provide against interruption of the service in cases of emergency. Thus both buildings may receive steam from the central plant, or the Mining Building can receive steam through the same pipes from the boilers in the Mechanical and Electrical Engineering Building.

The steam mains and the return pipes are laid side by side, and where possible at a uniform upward grade from the heating plant of about one inch in ten feet. The pipes are of wrought iron, and are laid in a high grade of air-

THE HEARST MINING BUILDING.

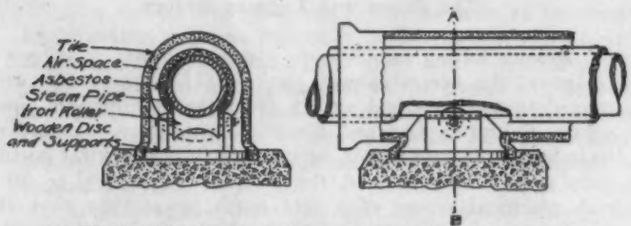
The low-pressure gravity system, in which radiators are employed, is already in operation in the Library, East Hall, Hearst Hall, Spreckels Physiological Laboratory, and the Student's Infirmary. The work of equipping the Faculty Club, Senior Hall, the Chemistry Building and the Agricultural Building, is already under way.

On the southern edge of the Campus, just above the Telegraph Avenue entrance to the grounds, is located a red brick, fire-proof building which houses the central heat, light and power plant of the University. The site has been so selected that as the needs of the various departments are increased, this building can be enlarged to house the extra equipment.

At this plant steam will be generated at 150 pounds pressure and passed through a reducing valve into the steam-heating mains at a pressure of about 25 pounds per square

cell asbestos pipe covering one inch thick. The canvas is painted with P. & B. paint, which makes the joints absolutely tight. The whole is enclosed in ordinary salt-glazed, vitrified tiling with an air space of one inch between the canvas covering and the inner surface of the tiles.

Ample provision for expansion in the piping is one of the most important factors to be considered in the design of a steam-heating system. A novel method of supporting the pipes underground to allow creeping during changes in temperature is used in connection with this system, and promises to give excellent results. As will be seen in the accompanying sketch, the bare under-surface of the pipe rests on an iron roller which is supported on wooden uprights fastened to a circular disc. This is set in the branch opening of an joint painted to make it tight. The whole rests on a bed of ordinary Tee tile and the disc is firmly fastened in and the



SKETCH SHOWING METHOD OF SUPPORTING THE STEAM PIPE.

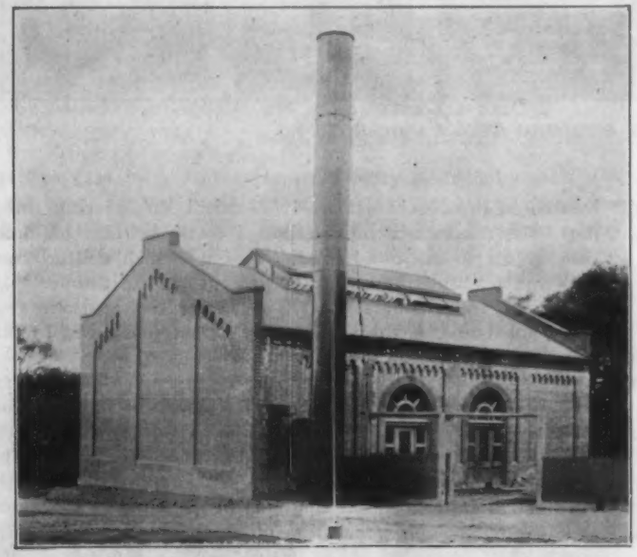
cement. These supports are placed at intervals of about 20 feet, and allow a longitudinal motion of the pipe with comparatively little friction.

In several of the concrete manholes, where the pipes branch, the branching fittings are laid in concrete with their upper surfaces just exposed. The rigid abutment thus formed causes the expansion to be entirely in one direction. The changes in length are taken care of by unbalanced expansion joints placed in other manholes. The pipes on entering a building, are usually suspended from the cross beams of the floor above by short chains, to maintain the elasticity of the system.

The steam pipes, on leaving the plant, are either six or seven inches in diameter, but are reduced in size to, in some cases, a diameter of two inches, according to the calculated amount of steam to be supplied. The return pipes vary in diameter from three to one and one-fourth inches.

In the several manholes are placed gate valves, a combined separator and steam trap for the condensed steam, and a thermostat with a thermometer to prevent the flow of steam in the return pipes above a certain temperature.

In such buildings as are heated by the low-pressure gravity system, the steam enters the building at a pressure of about 25 pounds and is passed successively through a stop-valve, a combined separator and steam-trap, another stop-valve, a reducing valve, a safety valve and a thermostat. The steam loses its water of condensation in the separator and passes through the reducing valve at a pressure of one pound or less, at which it is distributed throughout the building. The safety valves are set to blow off at about ten pounds and the thermostats insure a reasonable efficiency of the system by preventing steam from passing into the return pipes until it has lost a considerable amount of heat. Pressure gauges and thermometers are used in connection with the above apparatus to supply such information as is required for good regulation.



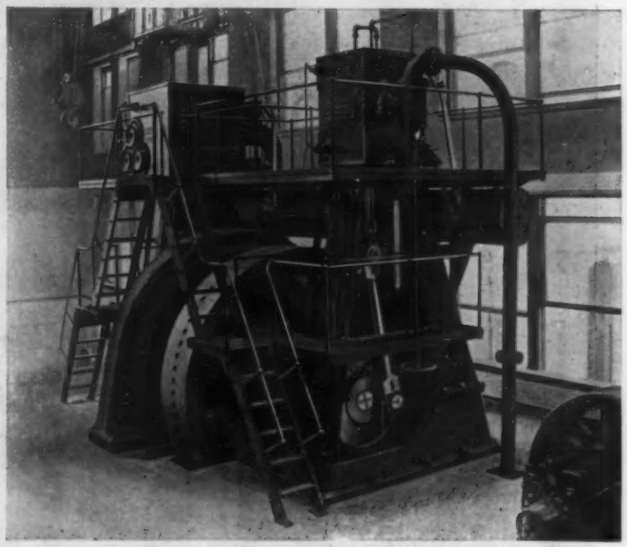
CENTRAL POWER AND HEATING STATION.

Some steam is necessarily condensed in transmitting it underground for distances of several hundred feet. This necessitates the use of separators and steam traps. In buildings all taps are taken off at a vertical angle of 45 degrees, sloping upwards, to prevent water in the distributing main from passing into the branch pipes along with the steam.

In the construction of this system, only the best quality of material has been used, and the highly satisfactory results already obtained more than justify the additional expense.

Several hundred shower baths are in use in the Harmon Gymnasium and in Hearst Hall, which is the women's gymnasium. Water for these is heated indirectly in long cylindrical steel tanks by passing steam from the main supply through pipes set longitudinally within the tanks.

The Students' Infirmary will be heated by the low pressure gravity system of indirect radiation. Zenith flue box-base radiators will be installed in front of openings in the walls communicating with a source of pure air. The incoming air in circulating around the heating coils of the radiators, will become warmed before passing into the rooms.



McINTOSH-SEYMOUR CROSS COMPOUND ENGINE IN CENTRAL POWER STATION.

Pure water for hospital use will be obtained by means of an automatic filter of novel construction to be operated on the steam line of the building. It is estimated that about 300 gallons of distilled water, both hot and cold, will be available during a period of twenty-four hours.

In California Hall and the Harmon Gymnasium, where the combined system of heating and ventilating has been in use for some time, the fans are driven by induction motors operating at 220 volts. The fan in California Hall is 4 feet wide and 8 feet in diameter.

Power Plant Equipment.

The boiler equipment of the central power plant consists at present of three Babcock and Wilcox patent safety water-tube boilers designed for a maximum pressure of 200 pounds. Each boiler is supplied with a super-heater, and has 1088 square feet of heating surface and 90 square feet of grate surface. The maximum capacity of each is about 218 horsepower. Two boilers are operated in battery and the other singly. Floor space has been allowed beside the latter for the installation of another boiler of similar type as soon as additional steam is required.

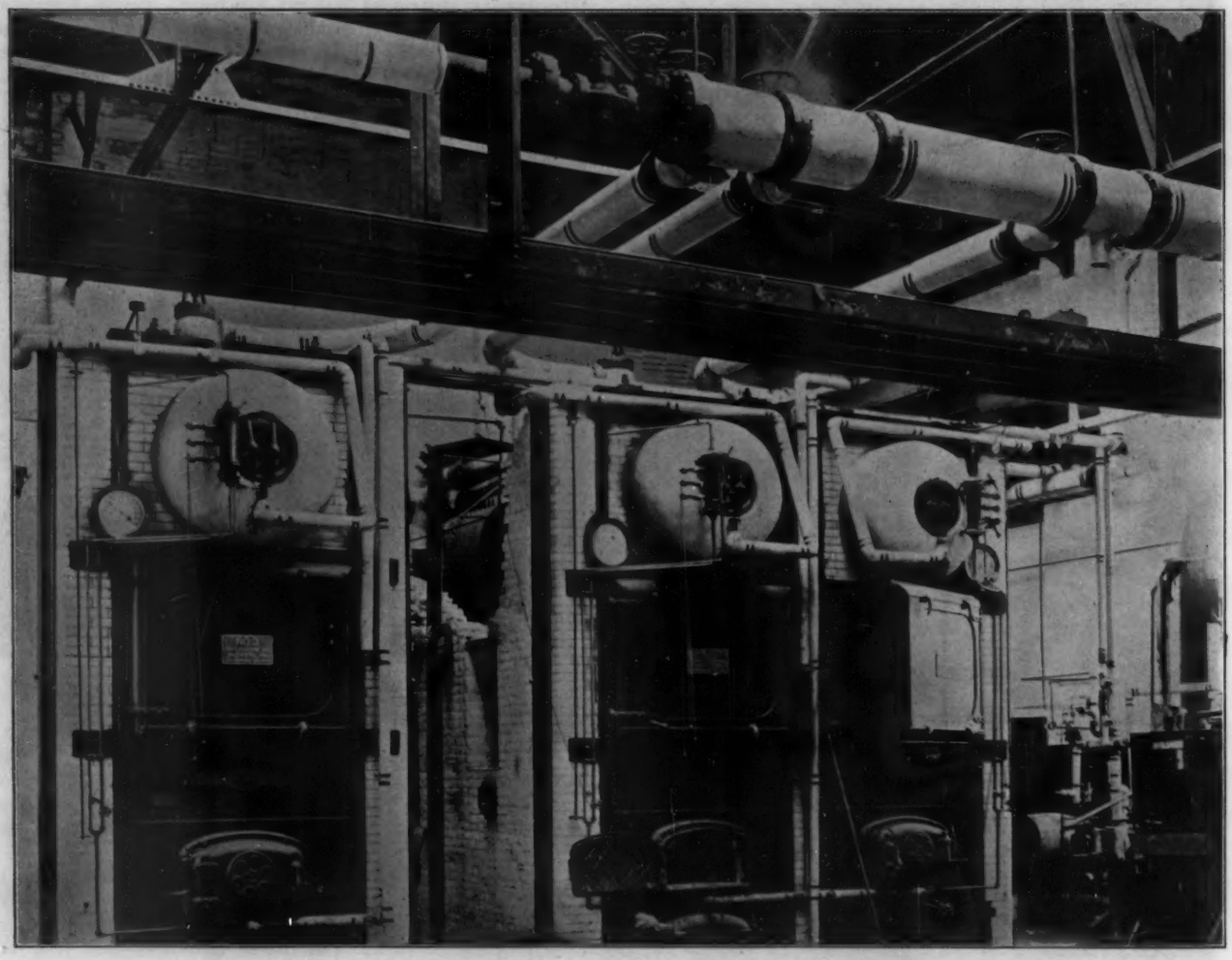
The furnaces are oil burning, being equipped with P. and M. burners. The auxiliary equipment includes one Hoppes 260-horsepower live steam purifier, two Snow duplex steam pumps, 5¼ by 3½ by 5 inches, and two duplex oil pumps of the same make, 3 by 2 by 3 inches. The above apparatus is located on the ground floor. In the basement, connected

to the return pipes of the steam heating line, is a duplex Worthington suction pump, 6 by 8½ by 6 inches. The suction is 6 inches, and the discharge 6 inches. Normally a vacuum of 20 inches is maintained.

For the generation of electric power a McIntosh and Seymour vertical, cross compound engine of the side-crank type has been installed. This is arranged for direct connection to a 200-kilowatt, 60-cycle, 2-phase alternator generating at 2,200 volts at 125 revolutions per minute. The capacity of the engine working at a gauge pressure of 150 pounds with a normal superheat of about 100 degrees, is about 350 horsepower. The cylinder dimensions are 12 and 26 inches by a 30-inch stroke. The engine is non-condensing, and may exhaust either directly into the atmosphere, or into the steam pipes of the heating system. In connection with the governor, a speed changing device is operated by an electric motor using exciting current. This allows a speed variation of four or five revolutions per minute for bringing separately-driven units into synchronism. This device may also be used for dividing the load between engines. Besides the above, dash pots are employed to prevent the oscillation of currents between two or more alternators operating in parallel.

Provision has been made for the installation of another similar engine-driven unit to be installed later.

Fuel oil for the furnaces is stored in a steel tank set in a pit just outside of the building. It can hold about 12,500 gallons of oil, which is about the capacity of the largest tank cars in use in California.



BABCOCK & WILCOX BOILERS, SHOWING STEAM CONNECTIONS.

The Power and Lighting System.

Besides having available the electrical power to be generated at the central power plant, the University has arranged to use electrical energy from the transmission line of the California Gas and Electric Corporation. In order to improve the load factor on its local line during the usual daily periods of light load, the company has agreed to furnish electrical power at a rate much lower than that at which it can be generated on the grounds. It is understood, however, that when the power demand on the company's line is heavy, the University plant will carry its own load.

Power will be received from the Temescal power house at 4,000 volts, three-phase, and transformed to 2,000 volts, two-phase by two 75-kilowatt oil-cooled transformers to be located in the Mechanical and Electrical Engineering Building. The power will be distributed to the various buildings through an underground conduit system, which will do away with the unsightly pole line at present on the campus. By means of transformers placed either in the basements or near each building, the voltage will be stepped down to that required for lighting and other purposes.

A considerable amount of direct current at 220 and 110 volts will be used in operating the elevators in California Hall and the Hearst Mining Building, and for driving the variable speed motors in the printing office. To supply this a 50-horsepower induction motor will be installed in the Mechanical and Electrical Engineering Building to drive two 25-kilowatt, 125-volt generators mounted on each end of the motor shaft.

The reason why this machinery, as well as the large transformers, are to be located in the Mechanical and Electrical Engineering Building rather than in the central power plant, is that the greater amount of the power will be consumed in the vicinity of this building; besides, the power company prefers to run its line in on this side of the campus rather than on the side on which the power plant is located.

At present the University gets its electrical energy for power and light from two sources. A single-phase line of the California Gas and Electric Corporation enters the Mechanics Building at 2,200 volts, and is transformed down to 1,100 volts for distribution from the switch-board in the engine room of the same building.

Here are in operation a Westinghouse 45-kilowatt, 125-volt, direct-current generator and a 40-kilowatt, two or three-phase Westinghouse alternator. Both of these units are indirectly belted to a non-condensing Ball engine rated at 100 I. H. P., and of cylinder dimensions, 12 by 12 inches. A General Electric constant-current transformer of 21-kilowatt capacity and of primary voltage equal to 1,100, supplies current for the arc lamps used in lighting the grounds.

In the boiler room, adjoining the engine room, are two Babcock and Wilcox water-tube boilers set in battery. The larger has a capacity of about 100 horsepower, and the smaller about 75 horsepower. The auxiliary apparatus includes purifier, heater, steam and oil pumps. Before the present coal famine coal was used for fuel, but the furnaces are now burning oil.

A 12,500-gallon fuel-oil tank similar to the one installed at the central plant, is now being installed. Two smaller tanks are now in use. These will be interconnected with the large tank by pipes and valves so that three grades of fuel-oil can be available at one time for testing purposes. This will be a valuable addition to the experimental equipment of the department.

In one of the electrical testing laboratories is a Westinghouse 40-kilowatt, 1,100 volt, two-phase alternator belted to a 50-horsepower, straight-line engine of dimensions 9 by 12 inches. This generator is used principally for supplying current for the testing laboratories, although it is frequently made to serve on the lighting circuit.

Up to the present time the generators in this building have been supplying the greater part of the electrical energy consumed in the various buildings and on the grounds. But as soon as the generator in the central power plant has been installed, this entire equipment will be used more especially to supply the requirements of the departments of mechanical and electrical engineering.

PROOF THAT TELEPHONE INSTRUMENT CONTAINED DEADLY CHARGE OF ELECTRICITY CASTS BURDEN ON COMPANY OF SHOWING THAT IT WAS NOT NEGLIGENT.

A case from Pennsylvania recently decided by the highest court of that State contains an important ruling on the above proposition. The facts were that one Delahunt's telephone had in some manner become out of order and had remained so for some days. He had received a notice from the manager of the company that the telephone would be repaired as soon as possible, and was waiting until he could use it again. One evening he heard a sharp clicking of the instrument, and thinking that it had been repaired, went over to it, and with both hands lifted the receiver from the hook, when suddenly there was a flash, and Delahunt fell lifeless. The above proof constituted practically all of the plaintiff's case. No testimony was offered by the defense, thus raising the question whether under such a state of facts the defendant is required to prove that it was not responsible for the accident; in other words, whether under such a showing the presumption is that the company was or was not at fault. This is a question of great importance, as it can readily be seen that the burden of proof in negligence cases of this sort will be shifted one way or the other, depending on the conclusion given. The following quotation from the decision of Justice Brown, who wrote the opinion, is sufficiently clear to need no further comment:

"Electricity is the agent by which telephones become the means of communication from one point to another, and it may be conceded, as the appellant contends, that the current needed for their use is not a dangerous one. In this case it may be still further conceded that the current with which the deceased came in contact did not come from the exchange of the defendant company; but at the same time it cannot be questioned that it came over one of its wires leading to the telephone of one of its patrons. Though the wire was intended to conduct only a harmless current, the defendant was bound to know that it could become the conductor of a deadly one, and that such a current would pass over it if it was not properly insulated, and should come in contact with a wire heavily charged. Its duty to its patrons was to exercise at all times the highest degree of care and vigilance to protect them from a dangerous electric current over its wires from any source. This is the implied undertaking of every telephone company, and * * * when there is an accident which in itself affords reasonable evidence of negligence, it must show why it should be relieved from liability."

At the trial the company asked that it be relieved from liability on the ground that the deceased having admitted that he heard the click of the instrument, had a warning of danger. The Supreme Court said that this position might be tenable if the current ordinarily carried over a telephone wire were dangerous, but since the fact is otherwise, Delahunt did nothing that in law could be considered contributory negligence, and that the defendant could not escape responsibility on this ground. A verdict of ten thousand one hundred seventy-five dollars and eighty-nine cents ($10,175.89) was therefore affirmed. While there is nothing in the case tending to establish that the company was in any way at fault its inability or failure to prove affirmatively that it was not, cast upon it the responsibility of paying this enormous verdict.

Delahunt v. United Telephone & Telegraph Company, 64 Atlantic 515.

An efficient protector at the instrument would have saved the company over $10,000.

ELECTRICITY IN INDIA.

In a report to his Government by the United States Consul-General in Calcutta there are indications of openings in parts of India which it behooves manufacturers connected with the electrical industry to keep in view. The consul advises builders of electrical roads and of electric cars and appliances to send representatives to the State of Mysore, and, in addition to pointing out the most direct routes by which to reach that State, he mentions the most important cities which should be made headquarters—viz., Bangalore and Mysore. He reports that the Mysore Government have recently passed a tramway (electrical road) regulation which extends to the whole State of Mysore, although primarily conceived to meet the convenience of the Mysore Manganese Company. A project is on foot to build an electric line connecting the civil and military station with the old Bangalore City line, and other extensions from that point. The whole system can be furnished with electricity from the Cauvery Falls, a head of water quite sufficient for not only the tramways, but for lighting purposes and mills and factories. It is to be hoped that British electrical engineers and manufacturers of electrical goods will not allow these opportunities to escape them and pass into American hands, and that they will thoroughly investigate the openings that have occurred in Mysore State.

THE WIRING OF SMALL CENTRAL STATIONS.*

The Work and Responsibility of the Erecting Engineer.

The installing of cables, small wiring and accessories in central stations and isolated plants of small and medium size, is too frequently given secondary consideration. The operation of any electric plant unquestionably depends largely upon this factor, and it is remarkable how some plants are operated for long periods under most adverse conditions, in so far as the wiring is concerned. The successful operation of a plant frequently depends upon the ability of the erecting engineer to decide as to the details of wiring, as little or no consideration may have been given to such matters previous to the arrival of the generators and other machinery, especially if the contract includes his supervision of all construction. It is, therefore, necessary for the erecting engineer to be prepared to decide and answer questions upon this subject which will include the size of cable required for main and field leads and methods of supporting them; the location of switchboard, means of supporting it, and the best method of wiring from the generators to the switchboard and feeder lines. Should the station be used for supplying current over long distances for light and power, it frequently becomes necessary to decide as to location of transformers, number and location of lightning arresters and method of carrying feeders out of the station; and if the plant be that of a manufacturing concern, information is often required as to the wiring of shops for light and power, the best method of supporting motors and starters and sundry other electrical and mechanical data which does not strictly appertain to the work immediately covered by the contract. The writer has learned by experience that it is advisable to impart such information freely to local engineers and electricians when it is called for and sometimes without being called upon, when the general conversation indicates that such information will be appreciated. At times it is necessary to volunteer information to insure a satisfactory installation from the standpoint of the manufacturer of the apparatus. One must be careful, however, not to imply that the informant knows it all. It must be borne in mind that many local engineers have not had the advantage of general observation and experience which comes from installing apparatus in many stations of different construction; also that they are frequently familiar with local conditions, a knowledge of which would be of great value to the erecting engineer. Consequently there is often much to be gained by an interchange of information along these lines, not the least of which is the feeling of good fellowship and confidence which usually results.

Some of the various features requiring consideration by an erecting engineer in the equipment of a plant may perhaps be best given under the following classification:

1—Switchboard—Location, supports and instrument wiring.

2—Generator Cables—Size, method of support, terminals and connection to generator and switchboard.

3—Feeders—Size and method of support.

4—Lights—Location, number and kind.

5—Motors—Size, supports and method of drive.

6—Starters—Style and method of support.

7—Protective Apparatus—Fuses, circuit breakers and lightning arresters.

Switchboard.

The switchboard should be located so that all generator leads will be as short as possible, especially if the voltage is five hundred volts or less and where direct-current generators are to be operated in parallel and require leads of similar resistance. For high tension service the switchboard should be located with particular reference to safety, preferably above the engine room floor. The switchboard should be rigidly supported, using insulated braces if possible. If the angle frame is to rest on channel irons, the latter should be leveled and secured to the floor before erecting the panels. In placing panels care should be taken to get them level and plumb and to avoid leaving spaces between adjacent sections. When the panels are in place, the instruments and rheostats should be carefully mounted and correctly connected.

All small wires should be rigidly supported and all joints, no matter how small or apparently unimportant, should be well made. This can be accomplished by using the "Western Union" joint, which should be soldered and carefully taped. After the small wires are in place a coat of black shellac on all taped joints will add to their durability and appearance.

Generator Cables.

To determine the size of generator cables, the amount of current, voltage, and distance between generator and switchboard must be considered, such a size being selected as to make negligible the drop in voltage between the generator and the switchboard. The cables can be placed in conduit or exposed as may be best adapted to the particular requirements of the station. In alternating-current systems it is impracticable on account of the inductive effect to carry each lead in a separate iron conduit. Whether the system be single or three-phase all leads should be in one conduit of non-conducting and non-inductive material. With a two-phase system the two leads of each phase can be run in one metallic conduit, one lead neutralizing the effect of the other. When laying conduit, bends should be eliminated as far as possible, and those that are necessary should be of large radius. When cables fit tightly an application of powdered soapstone will make them slide through the conduit more readily.

The question of insulation must necessarily be given careful consideration, and the kind used will depend largely upon the voltage and method of support. If cables are to be laid underground and exposed to extreme dampness, properly insulated cables with lead sheaths are necessary. In some localities the Underwriters' Rules will largely determine the insulation which must be used whether wiring is installed in conduit, moulding or open work. When wiring is exposed the insulators and supports should be rigid so that the cables may be put under tension. To make a satisfactory appearance, all wiring should be strung tight and straight and all bends made at right angles. Whenever possible on long spans of heavy cable, it is advisable to use strain insulators at each end with a turn-buckle at one end.

Cable terminals at both the generator and switchboard ends should be carefully soldered. To do this successfully remove enough insulation from the cable end to allow it to enter the terminal to the full depth of the hole. Clean the cable end and terminal thoroughly and then heat the terminal and fill it with solder. The cable end should be heated at the same time and tinned in a pot of solder. Then the cable end should be inserted in the terminal, particular care being taken to see that the terminal, cable and solder are sufficiently hot to make a perfect joint.

Feeders.

After selecting the proper size of feeder the best means of support should be decided upon. The most modern and satisfactory method is to place all feeders, within buildings, in conduit, but on account of the extra cost for this class of work open work is frequently used. It can usually be installed in such a way as to give satisfaction except under certain conditions. Reference to the Underwriters' Rules will show, for instance, that open work is largely prohibited in cellars or elsewhere below street levels.

*From "The Electric Journal," by S. L. Sinclair.

Lights.

The size of wire used in buildings can be considerably reduced by allowing for a slight drop in voltage between the switchboard and the point of consumption. An allowance of five per cent is not excessive and is advisable in most cases, when generators can be operated at a voltage to provide for such a drop and thereby maintain the voltage required at motors or lights.

The illumination of buildings is an art in itself, and to secure ideal results requires much study and observation. The erecting engineer has, at least, had the advantage of observation and can therefore advise as to the proper placing of lights for particular purposes, after having found that certain methods give satisfaction in other buildings under similar conditions.

Motors.

The number and sizes of motors to be installed is generally disposed of at the time of placing the order for the generators. Subsequent units, however, are frequently required and the erecting engineer may be called upon for information in regard to them. The horsepower required to drive a given amount of machinery is always an uncertain quantity and to determine this it is well to make an actual test, using any motor of sufficient capacity that may be available. The tendency in most cases is to figure too closely, thereby keeping down the first cost but providing a motor too small for the purpose. Undue overloading of a motor has proven to be poor economy on account of the frequent repairs and the resulting expense and loss of time.

The method of drive and distance between centers is an important factor and deserves careful consideration. Should the distance be too short for proper belt surface on the pulleys, chain drive or gears can frequently be used to advantage.

Starters and Controllers.

The starter or controller required for a given motor will of course depend upon the characteristics, style and size of the motor and the purpose for which the motor is used. The controlling apparatus should be rigidly and securely installed and readily accessible.

Protective Devices.

It is advisable to use a switch and circuit breaker, or the two combined, to properly limit the current and protect the apparatus. This arrangement obviates delay due to the replacing of fuses at times of excessive overload. Although the first cost of a circuit breaker is greater than that of fuses, yet in the long run the former will generally be found to be the most economical.

Lightning Arresters.

When current is carried from or to buildings over aerial lines, lightning arresters should be used as a means of further protection to generators, switchboard, motors, lights and buildings. There are various types of apparatus on the market to suit the requirements of the different kinds of service, their selection and adjustment depending upon the voltage and capacity of the system and local conditions. The nature of the soil available for the ground connection, the immediate surroundings of the line especially as to other wires and the probable extent of the lightning discharges should be carefully considered.

System.

Much has been said and written with reference to the subject of systems, and too much stress cannot be laid upon its importance. It is essential to efficient management and workmanship, regardless of the nature of the work or business. In supervising the installation of the machinery in a power plant, the erecting engineer must first turn his attention to the calculations. Drawings and schedules covering apparatus and material to be installed must be prepared and a plan carefully thought out as to the method to be followed in placing the apparatus. The work can then be done more effectively in every particular and will invariably effect a saving of labor and material. If the work is properly systematized the personnel of the management or working force can be more or less changed without serious results, and this is especially desirable in the case of an electrical installation where the engineer in charge is liable at any time to be called away or detailed elsewhere. His successor can, under these conditions, continue the work with comparatively little difficulty.

ENGLISH TURBINE PROGRESS.

The turbine vessels of the year make a good-looking collection, set out as they are in this fashion:

Vessel.	Tons.	Builders.
Lusitania	33,000	John Brown & Co.
Mauretania	33,000	Swan, Hunter & Wigham-Richardson.
Immingham	2,009	Swan, Hunter & Wigham-Richardson.
H. M. S. Dreadnought	17,900	Portsmouth Dockyard.
Rewa	7,003	Wm. Denny & Brothers.
Creole	6,000	Fore River Company, U. S.
Yale	4,500	Delaware River Co., U. S.
Governor Cobb	2,525	Delaware River Co., U. S.
St. George	2,456	Cammell, Laird & Co.
St. Patrick	2,387	John Brown & Co.
St. David	2,387	John Brown & Co.
Marylebone	1,972	Cammell, Laird & Co.
Viper	1,713	The Fairfield Company.
Kingfisher	871	Wm. Denny & Brothers.
Duchess of Argyll	583	Wm. Denny & Brothers.
Atlanta	486	John Brown & Co.
Five T. B. D.'s	1,500	J. S. White & Co.
Three T. B. D.'s	631	J. I. Thornycroft & Co.

Here there are high-speed ocean liners, speedy cross-channel boats, a battleship, and several destroyers. Turbine vessels in course of construction and still to launch show quite as remarkable variety. On hand are certainly no "Lusitanias" or "Mauretanias," but there are three "Dreadnoughts" and three "Invincibles," and a new batch of fourteen destroyers. The only thing on which the world waits apparently is the cargo boat of which Mr. Parsons spoke at the Royal Institution last Winter, in which steam turbines were to be used in conjunction with reciprocating engines. If that combination prove successful, we imagine, the last will be heard of turbine criticism. A great deal of the criticism at present gets its color from hte trouble there has been with some of the propellers, and people listen to it as if there had never been any trouble with the propellers of reciprocating ships. Probably we are nearer a solution of the propeller problem, through these trubine trials, than we have ever been before. In any case the world of engineering will be none the worse for this reconsideration of the question in its elemental simplicity.

HIGH GRADE COPPER.

The native mass copper of Lake Superior has the highest electric conductivity of any known copper. A sample cut from the most compact portion of a mass, rolled and drawn into a wire of 0.104 inch diameter and annealed, gave a conductivity of 102.5 Mathiesson standard. Cathode copper, carefully deposited with a low current and prepared in the same way, gave just as high a conductivity.—"Scientific American."

ALCOHOL AND FUTURE POWER PROBLEM.

Modern civilization is based upon the use of power—upon engines of one type or another. In large measure the power is derived from fuel. In cooler climates our comfort in winter is to a great extent a question of cheap fuel, while the various processes, such as the smelting and working of metals, the making of glass, the baking of porcelain, and so on, are factors in the gradual exhaustion of available combustibles—coal, peat, oil, gas and wood of the forests. Practically our whole problem of over-sea transportation is a fuel problem. Our land transportation is the same to an almost equal extent. Occasionally a waterpower is available, to furnish, through the agency of electricity, the energy required for a railway, but the coal or oil-consuming locomotive will, doubtless, hold its own for a long time, except in the most densely populated districts. Where electric locomotives or trains are used, the power station will still depend in most cases upon fuel. The population of the world and the expenditure of fuel for heat, light and power steadily rises. A time must come when, under the continued and increasing drain, the cost of fuel will be increased, and the available supply diminished, until the advancing cost due to scarcity and distance of haul will at last check the consumption. Our heating in winter is a peculiarly wasteful process. Our buildings leak heat all over. We consume enormous amounts of fuel to maintain temperature conditions which are worse than wasteful. We oftentimes maintain temperatures indoors in winters in excess of those we seek in summer when we flee the city. In our heating and ventilating systems we assume that when we discharge the air we must discharge it hot, and take in fresh, cold air, giving it fresh heat from fresh fuel. This is all wrong. What we will be compelled to do when our fuel cost is increased will be to transfer the heat from the escaping warm air to the cold supply by a system of regeneration, supplemented by a construction of buildings which will cut off heat leakage and waste from that cause. In this way the air leaving a building will pass through a structure like a regenerator and will there deliver its heat to the incoming fresh air. Such regenerators can work at quite high efficiencies. The regenerating system will also be appplied more extensively than at present to furnace processes, and waste furnace heat will be conserved for various uses. But when all this, and more, is done, the fuel question will still exist. The crisis, though delayed, must assuredly come. It avails little to say that in China there is coal to supply the world for hundreds, if not thousands, of years. We may not control that supply; the cost of transporting it may make its use almost prohibitive. Our fuel supply is the result of solar radiation in the geological past. Energy of the sun was stored in the earth millions of years ago. Our waterpowers are the result of solar radiation in the present; the water evaporated from the tropic seas is deposited on the cooler heights of land, and we incidentally use a small fraction of the energy play involved. Solar radiation must continue to be the source of our power and heat. The growing plant can, by cultivation in the favored districts, be encouraged to assimilate, so to speak, the solar energy. We already have the timber of the forests, the brush wood, the straw of the wheat. field. The ideal fuel, however, is, undoubtedly, liquid fuel of a nature to be readily vaporized. If the liquid be of a limpid, non-viscous character, the difficulties found in pipe-line transportation with the thick fuel oils will not stand in the way of such transportation and distribution. Fortunately, we have in ethyl alcohol an ideal fuel—colorless, limpid, of moderate boiling point, about fifty degrees below that of water, non-freezing, burning without smoke, mixing with water in all proportions, and, therefore, its flame extinguished by water, cleanly, drying off completely when spilled, not attacking rubber gaskets or packings, and non-corrosive for metal tanks and holders. The fact that its flame is bluish, or so-called non-luminous, means that the flame is almost devoid of free carbon particles, with their intense heat radiating power, a fact of considerable importance. When gasoline or heavy oils are burning, the flame, loaded with free carbon or soot, radiates heat to such a degree that it is not possible to approach near the conflagration, and combustible surroundings are readily fired by pure radiation of heat. The production of alcohol on a large scale is very simple, and the raw materials already exist in considerable variety. All saccharine or starchy growths are available. Saccharine wastes are now largely used in Cuba for alcohol production. At present it is said that the low grades of molasses can be delivered at American coast cities at about three cents per gallon. About three gallons of this crude product will be required to produce a gallon of refined spirit, or ninety per cent. alcohol, and the cost of production may be estimated at from three to four cents, making the cost of the alcohol per gallon about twelve cents. This alcohol will, in a properly organized engine, equal, volume for volume, gasoline now sold at a much higher price, in producing power. Even in the immediate future, then, it is evident that alcohol has a large field of usefulness. The farmer need not depend on wood, coal or oil for his power. His agricultural wastes will furnish it. His fields need only receive the sunshine, and be given sufficient water, and thence any crop yielding starch or sugar, however unmarketable otherwise, may be made the source of power, light and heat. The use of alcohol as a fuel, and as a source of power, will grow gradually. It would be idle to look for any sudden revolution in methods. It would, in fact, be very undesirable. Revolutions are destructive. Evolution, a slower process, is constructive. Gradually a system of production and distribution must be evolved, even for present needs. But when we extend our vision into the far future, we can only speak of possibilities or probabilities. There is always a possibility of new discoveries modifying conditions to such an extent that our best present judgment may be in error. But assuming that increasing scarcity and cost of mineral fuels will gradually stimulate the selection and use of substitutes, it seems reasonable to predict that the one substitute which possesses the most desirable qualities is ethyl alcohol. The amount that can be produced is practically unlimited. A very important fact distinguishing alcohol production by agriculture from the production and shipment out of the land of food products, meat, etc., or even wood, is that in the former the land is not impoverished, as the mineral and nitrogenous matters can be returned to it, while in the food and wood carried away the richness of the land is passing away, too. Alcohol contains only carbon, hydrogen and oxygen, all of which come from the air itself. The transformation is begun in the carbonic acid and water of the air reaching the growing plant under the influence of sunshine, and completed in the fermenting vat and the still under human direction. Vigorous plant growth is a cooling process; solar energy is rendered latent or potential. It would even be possible to calculate from the fuel value of any growth or crop the proportion of the solar energy so stored up. Fermentation renders the energy stored more available, and distillation finally yields a concentrated product. It is not unreasonable to expect that, in large engines of the internal combustion type when highly developed, we may attain efficiencies of thirty or forty per cent. This means that of the head units potential in the fuel, and liberated when it is burned with the oxygen of the air, about one-third may be converted into available power. It may even be that future invention will carry this proportion up to about one-half. With alcohol at a cost of ten cents a gallon—a price even now realized in Cuba—the cost of fuel per kilowatt-hour would be about one cent and a quarter on an assumed efficiency of thirty-three per cent. in the engine. It is not to be imagined that where coal or oil can be obtained at anything like the present costs there is at present any possibility of their replacement. Neither is it likely that waterpower, developed under favorable conditions, can ever have as a rival artificially-produced fuel. But inasmuch as the fuel cost is only a relatively small fraction of the total cost of operation of a

great system of distribution, such as that of an electric lighting plant or railway, it is evident that, considering the great convenience and adaptability of the alcohol vapor internal combustion engine, a wide field may be open for its application, as the cost of the fuel alone is a relatively unimportant item. Certain it is, that for isolated small powers the alcohol motor can soon be used with convenience and economy in America, following the recent legislation, removing the onerous tax. As to the more distant future period, we need have no misgiving. We are assured that mankind, by the introduction of methods of economizing heat, and by artificially producing liquid fuel, will be able to maintain those activities demanding heat and power until "the sun himself grows dim with age, and nature sinks in years."—Elihu Thompson, in "Gas Power," St. Joseph (Mich).

INSULATING PROPERTY OF ALUMINUM.

The property of aluminum as an insulator in certain solutions which allows current to pass readily from the solution to aluminum, but not in the opposite direction, has been discussed in connection with lightning arresters in a paper read at the recent meeting of the American Institute of Electrical Engineers. Although the coating formed on the aluminum in various solutions is a good insulator, it has not a very high dielectric strength. With many solutions it breaks down at about 120 volts. There are others, however, which enable it to stand several hundred volts. The hydrocarbons of the aromatic series are particularly useful, as has been pointed out by Pollak. But if the potential be carried higher than the limiting value, the surface film breaks down, the opposing resistance disappears, and a path of low resistance is formed. It is this property that is utilized in as may be required are placed in series, but the device may be constructed so that, while presenting good insulation for the normal potential of the circuit, a comparatively slight increase will be sufficient to cause it to give way. For example, a group of plates may be arranged to resist perfectly 10,000 volts, yet at 12,500 volts will give way.

If further experience with the aluminum arrester proves it capable of all that is expected of it, it will be a valuable addition to lightning protective devices. It is probable that those disadvantages which seem to have retarded the use of the rectifier and condenser will not be so serious here, for lightning arresters placed either at the main generating station or at substations are taken care of. It is only when a machine is placed in the hands of some less responsible person that it suffers from lack of attention. The electrolyte must be renewed and the cell kept clean—features which are very apt to be neglected by those who do not fully appreciate their necessity. It is possible that these features may be sufficiently disadvantageous to prevent the use of the aluminum discharger on transmission lines, particularly because such a device must naturally be placed under cover, and well protected from the weather. But at those places on the system where employees are constantly in attendance, or where inspections are frequently made, the necessity for a certain amount of attention may be an advantage rather than a disadvantage. These inspections will insure that the protective apparatus is always kept in first-class order.

It remains to be seen how far this method of protection will be carried. Mr. Jackson has used it rather satisfactorily up to 40,000 volts, and from the character of the device there seems to be no reason why it should not be equally as satisfactory for 50,000 or 60,000.

TELEPHONES IN THE FAR NORTH.

Few persons realize the extent of the system of the Alaska Telephone and Telegraph Company of Seward Peninsula. Over 1,000 miles of wire is strung between the various camps of that region. The line from Nome to Tin City is the longest wire that the company is operating, being 157 miles long It is the only line in Alaska in which a submarine cable carries the messages for a part of the distance. This cable is under Grantley Harbor, near Teller. To guard against accident, an aerial wire is also strung, the poles on either side being 120 feet high.

The second longest line is to Candle Creek, a distance of 138 miles, from Council, the course carrying it through the Council district. There are two lines to Kougarok, one of 122 miles and the other of 130 miles. A wide expanse of barren, uninhabited country is covered by the Candle line, which was the cause of much hardship and heavy cost at the time of construction.

At Craft's Roadhouse, near White Mountain and the junction of the Niukluk and Fish Rivers, there is a telephone which is kept busy from morning till night by freighters and merchants between Chinik and Council. All the camps along Solomon River are provided with telephones, as are most of those on Nome River, Dahl and Taylor Creeks. The main exchange is at Nome, where there are two local switchboards and one long-distance board. There are 130 camps and roadhouses provided with telephones, in addition to numerous uated within the "city limits"business houses and cabins sit of larger camps.

POWER AT NIAGARA.

The discussion upon the Victoria Falls project, which has continued in the technical and daily papers with considerable vigor for some time, naturally has brought prominently forward the great and rapid development of Niagara. The general trend of the last decade has been to utilize, where possible, any water waste which is within reasonable distance of a demand for mechanical power. It has been estimated that over 100,000,000 tons of water plunge per hour over the Niagara Falls, and as this great mass of water drops 165 feet, it is clear that there is an enormous amount of energy available. The engineers employed by the Government of the United States have estimated the horsepower available at the Falls as being about 6,750,000. It is almost impossible to grasp what this would mean in the way of coal consumption if it were all generated by steam. Clearly it would be quite impossible to establish an ordinary steam station of anything approaching this capacity. The Niagara Falls Power Company, it will be remembered, appointed a Commission, over which that grand old man of science, Lord Kelvin, presided. It was decided, a few years ago, to install twelve turbines and dynamos of 5,000 horsepower each, and later it was determined to duplicate this plant because of the growing demand for electric power.—The (London) "Engineering Times."

GIFTS FOR THE LAND AND BUILDING FUND OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

Samuel Insull, president of the Chicago Edison Company, and C. L. Edgar, president of the Boston Edison Company, have each contributed $1,000 toward the land and building fund of the American Institute of Electrical Engineers. Both of these gentlemen are members of the Advisory Committee of the land and building fund. F. W. Roebling, of the John A. Roebling's Sons Company, Trenton, N. J., a member of the Institute since 1887, has also contributed the sum of $1,000 to this fund.

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EDITORIAL.

Power Plant Economy

The American Civic Federation has for years endeavored to secure legislation by the Federal Government to the end that the use of water by the electric power companies at Niagara shall be limited. The desire of this public spirited organization is to have some action taken before it is too late, and the famous falls are nearly or completely destroyed for the sake of cheap power. Mr. H. W. Buck, who for a long time has been closely identified with the development of Niagara power, compares the loss to the country by neglecting to utilize the power of the magnificent water falls to a great conflagration in which $122,500,000 are annually lost. From the standpoint of the people it is then a question as to the value, directly or indirectly, of maintaining the present beauty of Niagara. It is extremely doubtful whether the amount of water used at the present time by all the power companies is sufficient to be really noticeable at the falls. But for the future there is cause for serious reflection, and manifestly we cannot have both the cheap power or ultimately save over one hundred million dollars per year of the nation's wealth, and preserve the falls as they are now and have been for ages past.

Money is never lacking when its investment reduces the cost of a necessary commodity. Power for an innumerable number of purposes is one of the greatest requirements of civilization. Its use has increased at a greater rate than has the population or the nation's wealth. Energy in no other form is to be compared with electric power for adaptability, ease of control or the efficiency with which it may be transmitted great distances. Under present modern methods and with the use of the largest and most efficient apparatus the cost of producing electric power, including all costs, is less than ever before. The use of electric power is attended with a minimum of attendance, annoyance or cost. Compared to the needs of the next century the present requirements for electric power are without doubt very small. From what source must this great necessary factor in the world's progress and life come? Whatever may be the source it is safe to assume that methods of the greatest economy and efficiency will be developed and used.

Many engineers are not only deceiving themselves but their clients in their interpretation of power plant economy. Rarely, if ever, is a generating station operated continuously under the most favorable conditions as regards maximum efficiency. Absolute reliability of operation, minimum attendance and fixed charges and the smallest average annual fuel cost per unit of output is what is wanted by the owners of electric power systems using fuel in any form as a source of power.

Notwithstanding this, engineers are much given to confine themselves exclusively to mere portions of the whole problem. The efficiency of a unit at full load, the consumption of fuel per indicated horsepower per hour at maximum economy, or the kilowatts on the switchboard per ton of coal or barrel of oil burned, at normal rating, are all of little value, extremely misleading and more than useless when considered by the general manager or the directors of the company in determining the actual cost of producing power as required in the operation of their distribution systems.

If a particular unit cannot be depended upon for continuous use under even adverse conditions and like an automobile, is repeatedly in need of adjustment and repair, even if its efficiency is of the highest, it would find few friends in a power plant from the president of the company down to the oiler. Again, the highest efficiency of operation may be more than counterbalanced by excessive attendance charges. The total fixed charges, such as interest, insurance, and depreciation, are often such as to exclude a particular type of apparatus from the generating station. But most important of all is it, that a plant should be of high efficiency, annually, under the conditions existing in the particular plant, no matter what these may be, and not momentarily at some predetermined output near the point of maximum economy.

It was with a genuine understanding of just such points as are outlined above, that a director of one of our largest electric light and power companies in California insisted upon a commercial test under the regular conditions of operation, this test to be continuously conducted for a period of three months, before his company placed the contract for a complete twenty thousand horsepower steam plant, and further insisted that all guarantees be based upon the results obtained

from the commercial test of ninety days' duration. It would be well if all engineers and managers of electric power enterprises followed in effect the almost extreme example set by this wise director. It is also of importance to note that this absolutely correct method of determining the real plant economy from the fuel standpoint was suggested by a director of the company and not by any one of its numerous engineers.

BOOK REVIEW.

"After Earthquake and Fire." A reprint of the articles and editorial comment appearing in the Mining and Scientific Press immediately after the disaster at San Francisco, April of April 18th.

This attractive little book will prove a valuable memento and record of the trying days subsequent to the catastrophe of April 18th.

The A. Lietz Co., San Francisco.—A well-bound, vest pocket size booklet has been issued by the A. Lietz Co., giving the Solar Ephemeris for the year 1907. This will be found valuable by all civil engineers and surveyors.

This company will soon be in their new four-story, reinforced concrete building, now in course of construction at 632-634 Commercial Street, between Montgomery and Kearny Sts. A catalogue will be sent on application.

Smith, Emery & Co., San Francisco, announce by means of an attractive booklet that they are prepared to make complete tests of construction materials, water, fuel and illuminants, etc., and also to make expert inspections of various kinds.

"The Treatment of Storage Batteries," by R. W. Vicarey, author of "Storage Batteries and their Electrolytes," illustrated, published by the "Electric Accumulator," 15 Queen Street, Cheapside, London. Price, 2/6, net.

The author of this book has been associated for sixteen years with the manufacture and care of accumulators, and his purpose in writing is to treat of the installation and care of storage battery sets.

The matter is presented in a systematic way with subheadings which make it valuable to engineers or others interested in this subject.

The Electric Journal following out the plan of previous years, have issued an index suitable for a card index system covering all the preceding volumes.

The adaptation of articles in the Electric Journal to every branch of electrical engineering work is well known by all electrical engineers, and it is needless to say that this index in connection with the bound volumes of the magazine, will be of great reference value.

The General Electric Co. have issued a very attractive booklet on "Electric Heating and Cooking in the Home." It is well illustrated and will be of general interest to every consumer of electricity.

TRADE CATALOGUES.

Wendell & McDuffie, of 26 Cortland St., New York, have published a new 24-page catalogue describing their asbestos and cement fireproof materials. The method of manufacture of these materials, which may be used as a substitute for other building materials, is well described.

A supplement is also issued giving drawings and dimensions of the different-size slates, and describing the various methods of laying.

Sprague Electric Co.—A handsomely illustrated catalogue, describing the "Electric Equipment of a Modern Hotel," has just been issued by the above company.

ELECTRICITY THE SAFEST OF ALL POWERS.

An able analysis of industrial accidents by Dr. Josiah Strong under the caption "Our Industrial Juggernaut" appeared in the mid-November issue of the "North American Review." No one can read this article thoughtfully without being impressed with the need of an awakening of American industries on the subject of accident prevention, and we earnestly hope that active measures will be taken to reduce the serious economic waste and suffering which careless methods of production invite. At the same time we can not help pointing out that Dr. Strong is greatly mistaken when he includes the increasing use of electricity in machine driving as a contributory cause of more and more industrial accidents.

The electric motor in itself is one of the safest pieces of machinery in the world. It is compact, can be placed in the most inconspicuous and convenient locations, may be made both moisture and fool-proof, will stand tremendous overloads without breaking down, can not explode and in certain types will run in water, dust, mud, chemical fumes and extreme heat or cold. If anything like decent engineering is used in adapting it to the work in hand it will operate for long periods with little or no attention, and without overheating.

The electrically driven machine is the safest of all, provided the machine is individually operated, and even if it be belt driven the hazard is no greater than with any other method. In fact it is less, for even with group driving, machines can be shut down when not in service, and there is less obstruction to light and air than with belts and shafting entire. And finally, the electric wire is safer than the steam pipe with its explosive powers, the gas pipe with its inflammable contents, or the compressed-air main with its heavy pressures and possiblities of rupture. Of course, high-potential circuits are dangerous if not properly installed and maintained, but the point is that there is an intrinsic accident hazard about other means of power supply that is quite foreign to electricity. In the largest field of electric motive-power application—the electrified steam railroad—we believe operating experience will prove that the electric locomotive is far and beyond safer than the smoke-emitting steam locomotive of the present; and in the smallest field of electric power—the operation of toy motors for children's play—there is no question about the greater safety of the electric machine in comparison with gas or alcohol toy engines. We believe that it can be demonstrated in every case that the use of electricity increases the operating safety of the industry which adopts it, and that any industry employing electric power in contradistinction to older methods will have fewer accidents as a result.—From the "Electrical Review," New York.

INCREASED VALUE OF COPPER EXPORTS.

According to a bulletin published by the Geological Survey the production of copper in the United States in 1905 exceeded 901,000,000 pounds. The three leading regions of production are Butte, Mont., Arizona and the Lake Superior region. In Idaho and Utah there was a marked increase, while in California and Tennessee there was a decrease. The total production for the world, in long tons, for 1905 was 701,252. The exports of copper in 1905 in its various forms aggregated in value $86,408,731, or nearly double the value of the exports in 1903.

ILLUMINATING ENGINEERING SOCIETY.

On Friday, February 8th, 1907, a meeting of the New York section of the Illuminating Engineering Society will be held in the Edison Auditorium, No. 44 West Twenty-sixth Street, New York, for the election of officers of the New York Section for the ensuing year. Mr. Thomas J. Litle, Jr., of the Welsbach Company, will present a paper on the "Photometry of Incandescent Gas Lamps."

INDUSTRIAL

IMPROVED MOTOR-DRIVEN BLOWERS.

The illustration shows the motor-driven forge blowers manufactured by Roth Bros. & Co., Chicago.

Their distinctive features are: The blower wheel is mounted directly on the armature shaft; the blower casing is a part of the motor frame and carries one of the two bearings.

No other outfits can compare with these in efficiency, compactness and simplicity. They are a marked improvement over the usual form where the motor is just "stuck on."

Aside from the convenience and increased amount of work which can be done by their aid, the saving in cost for electrical power will pay for their installation in a few months. The motor runs only when the blast is required, and is stopped at other times. Speed controllers are provided by means of which the desired strength of blast is obtained, thus the electric power consumed depends entirely upon the amount of blast.

The motors are wound for direct or alternating currents, and are carried in stock in three sizes, suitable for horseshoers' fires, wagonmakers' fires and the large forges used in railway shops. Larger sizes are made to special order. Equally compact and efficient equipments have been made in sizes requiring as much as 40-horsepower, for supplying blast for large cupolas.

These blowers are also largely used for oil furnaces, gas furnaces, in starting gas-producer plants and many other places where low-pressure blast is required.

INCANDESCENT LAMP DISPLAY OF THE GENERAL ELECTRIC COMPANY AT THE CHICAGO ELECTRICAL SHOW.

The General Electric Company's collection of incandescent lamps is one of the features of the Electrical Show in the Coliseum at Chicago. Its exhibit space is thickly studded over head with the new incandescent units. Illustrations are given of all the newer lamps with various forms of Holophane reflectors. An ingeniously arranged flashing device presents the various forms and lights up, consecutively, Gem, Tantalum, Meridian and Tungsten lamps. There is also a "working" display of various standard carbonized filament lamps, including all of the miniature lamps. This is the first public exhibition covering all the different new types of incandescent lamps made in America, and illustrates in a most practical manner the wide range of illuminating units now available.

STARTING OF CARNEGIE STEEL GAS ENGINE.

Something over a month ago there was started at the Edgar Thompson works of the Carnegie Steel Co., Pittsburg, the first large gas power installation in America, using blast-furnace gas and double-acting, four-cycle gas engine of a large capacity. This event is of rather unusual importance as it marks the commencement of a new regime in methods of power generation of the U. S. Steel Corporation which has already taken so prominent a stand in favor of the internal combustion type of prime mover. The starting of the Carnegie engine also is of further interest for the reason that it furnished an effective demonstration of the capabilities of the Westinghouse design for the work in hand. This design, however, was by no means an untried one, as a number of gas engine units of similar design, but smaller capacity (500 horsepower) have been in operation elsewhere with success; but the Carnegie engine represents the first of the series of 12 large units (3,000 horsepower) which are now being built by the Westinghouse Machine Co.

The Carnegie blowing unit was started for the first time on December 7th, and after a trying out period of only two days, was then put into regular commercial service. Since then the unit has carried commercial load during the regular daily run without developing external or internal defects either in structure or operation. A rigid inspection of working parts after a few days' run failed to uncover the least evidences of wear or excessive stresses, and during a month's daily operation no prematures or backfires have occurred.

In design the gas engine follows the same general lines as those of smaller Westinghouse units, previously described in the technical press. It is of twin-tandem, double-acting style with center-hung flywheel and with two air tubs arranged in a "vis-a-vis" fashion opposing the two engine frames. The gas cylinders are 38 inches in diameter by 54 inches in stroke, and air cylinders 60 inches in diameter; normal speed 60 to 75 revolutions per minute. Engines of the same size are being constructed for electric work in which case the air tubs are removed and a generator mounted upon the shaft next to the flywheel. The generator will have a rated capacity of 1,500 kilowatts, running at 75 revolutions per minute. Such a unit is now under construction for the Edgar Thompson plant. The generator will be solid coupled and will deliver direct current at 250 volts.

Although this gas engine unit furnishes an uninterrupted supply of air for blowing purposes, the duty imposed upon it is by no means uniform. Owing to changes in the compactness of the furnace burden the air pressure must vary in proportion. The usual range is 14 to 20 pounds per square inch, except when the furnaces are tapped, when the pressure reduces to 5 pounds. On the other hand, when the furnaces are closely packed the pressure may increase to 20 pounds. These variations in pressure delivery are accompanied by corresponding variations in the quantity of air delivered, all of which is taken care of by the valve gear, while the speed of the engine is entirely under the control of a sensitive centrifugal regulator designed upon the relay principle but controlling the gas inlets individually and directly at the point of gas supply. A speed changing-mechanism provides means for manual control of the speed of the blowing unit when desired.

Compressed air is employed, as usual, for starting, and it is a point worthy of note that this large unit has been started and placed under full load in 53 seconds from the time of turning on the air, while one minute is ordinarily sufficient.

As the starting is automatic, only gas and air valves require attention of the operator at the time of starting, no other parts of the engine needing manipulation.

Much experience has developed during the past two or three years in the operation of large gas engines on natural gas. It is, however, a point worthy of note that the use of "dirty" gas, either producer or blast furnace, is a very different problem, so difficult as to establish a very narrow margin between success and failure where the necessary experience in its use has not previously been acquired. But in adopting the large gas engine as a standard form of prime mover in steel plants, the Carnegie Steel Co. has not been blindly dependent upon skill of gas engine designers. For a long period a 500-horsepower Westinghouse gas engine of design similar to the large unit was maintained in daily operation at the steel plant for purposes of experimentation. Experience derived from the operation of this smaller unit gave unusual promise, which seems to have already been fulfilled in the operation of the large unit. During a 30-day test of 24 hours per day, including Sundays, this experimental unit sustained regular commercial load with but two stops (equivalent to a run of 99 1-3 per cent. of the elapsed time). One of these stops was due to failure of gas supply. At the end of this run the engine was found to be in excellent condition, no unusual wear had developed at any point and all moving part were working freely. This excellent record is not a little due to the effectiveness of the lubrication and cooling systems which have been devised for this double-acting design of engine.

From every standpoint the results that have been achieved with the use of blast-furnace gas at the Edgar Thompson Works constitute nothing less than a vindication not only of the design, but also of the action of the steel companies in adopting gas engines for general motive power throughout every department of their works.

EXHIBIT OF THE H. W. JOHNS-MANVILLE CO. AT THE SECOND ANNUAL ELECTRICAL SHOW, CHICAGO, ILL.

At the Second Annual Electrical Show, held in Chicago from January 14th to 26th, the H. W. Johns-Manville Co., whose headquarters are in New York, will have an extensive exhibit. Among its other numerous electrical specialties will be exhibited a line of "Victor" Direct Reading Instruments. These will consist of "Victor" Direct Current Volt and Ammeters, "Victor" Combination Meters, both switchboard and portable types, as well as a special "Victor" Combination Meter for automobile use.

The "Victor" Combination Meters are the only direct reading electrical instruments of their kind on the market, giving a simultaneous reading of volts, amperes, watts and horsepower on one dial.

Among the other materials exhibited should be mentioned "J-M" Friction Tape. In this tape the friction is well worked into the fabric and runs true to gauge throughout the entire roll. This tape possesses an extremely long life under all conditions.

"Noark" Subway and Service Boxes are shown, of one, two and three-pole construction and 250, 600 and 2,500-volt capacity. "Noark" Subway Boxes are water-tight, being designed and tested to withstand a pressure of 25 pounds per square inch without leaking, and are, therefore, suitable for the most severe conditions. Also a complete line of "Noark" National Standard Fuses, Blocks and accessories, and "J-M" Overhead Line Material were shown.

"Transite" Controller Linings are made of "Transite" Asbestos Fireproof Lumber, an insulating material which absolutely prevents short circuiting or grounding of controller cover. "Transite" Asbestos Lumber is also made in the form of Fireproof Doors, for high-tension transformers and switches, in which case it serves to protect the apparatus from short circuiting and to prevent persons from coming into contact with the live parts.

3269 HORSEPOWER TURBINE WHEEL FOR THE POST FALLS PLANT OF THE WASHINGTON WATER POWER CO.

In September of last year Mr. D. L. Hintington, the general manager of the Washington Water Power Company, visited the different turbine builders in the East and made a thorough inspection of the I. P. Morris Company's plant, and of the six 10,000 horsepower wheels that they are constructing for the Niagara Falls Hydraulic Power & Manufacturing Company, of Niagara Falls, New York, and also of the five 6,625-horsepower wheels which they are building for the Aluminum Company of America.

On December 11th, 1906, the I. P. Morris Co., of Philadelphia, Pa., received an order from the Washington Water Power Company, Spokane, Washington, for one 3,260 horsepower horizontal shaft turbine unit for the Post Falls plant.

The turbine will be designed to operate under a head of 45 feet, and to run at a speed of 138 revolutions per minute, and will consist of two bronze runners on a horizontal shaft, the runners being about 66 inches in diameter. They are enclosed in a plate steel casing. The bearings will be of the generator type, and the outboard bearing will be a ring-oiling, thrust bearing, to take care of the unbalanced thrust of the runners. At the tail end of the shaft there will be furnished a suitable brake. This brake will be similar in design to those now used on the I. P. Morris Company's wheels at Niagara Falls.

The water will be distributed to the runners through cast-steel guide vanes, which are operated by links and an operating ring on the outside of the casing. This operating ring will be connected by suitable links to the governor piston.

It is as yet undecided what make of governor will be used. Both the Glocker-White governor, which is built by the I. P. Morris Company, and the Lombard governor are now under consideration.

The power house has still room enough for two more units, beside the new one which is to be furnished by the I. P. Morris Company, which will make a total number of seven units when all are installed. The maximum capacity of the plant will be 24,000 horsepower.

At the present time there are installed in the power house three 3,000-horsepower wheels, which were built by the Platt Iron Works, of Dayton, Ohio.

CHASE-SHAWMUT COMPANY.

On account of the great increase in demand for the staple specialties manufactured by the Chase-Shawmut Company, and the consequent need of more room and machinery in their factory, they have sold out their entire patented theatre switchboard interests to James S. Pennefather, of New York. The Chase-Shawmut Company ask for Mr. Pennefather a continuance of the liberal patronage heretofore bestowed upon them.

With more space and machinery the Chase-Shawmut Company are better equipped than ever for giving prompt attention to the orders they may receive.

The Standard Underground Cable Company's business has grown to the extent that they have recently opened branch offices at Atlanta, Ga., Los Angeles, Cal., and Seattle, Wash. Tese officers are subsidiary offices to their other regular branch offices.
branch offices.

NEWS NOTES

TELEPHONE AND TELEGRAPH.

San Francisco.—The Pacific Telephone and Telegraph Company, which succeeds the Pacific States Telephone and Telegraph Company, and the Sunset Telephone Company, by merger, completed its organization at a recent meeting held in Martinez, by electing the following officers: Henry T. Scott, President; Louis Glass, Vice-President; E. J. Zimmer, Second Vice-President; T. E. Sherwin, Auditor and F. W. Eaton, Secretary and Treasurer. The office of general manager was abolished. The papers in connection with the merger have been filed by the attorneys representing the two old companies. Portland, Ore., will be the future headquarters of the concern.

Reno, Nev.—Captain Merardi, President of the Reno Stock and Bond Exchange, states that the brokers of Nevada have been unable to reach a satisfactory agreement with the Western Union Telegraph Company, and that sufficient capital has been secured to begin the construction of an independent telegraph line from Reno to San Francisco and from Reno to Goldfield. This line will in all probability connect with the Postal Company in San Francisco.

Oakland, Cal—At a meeting of the Emeryville trustees, recently, the Home Telephone Company made application for a telephone franchise.

Stockton, Cal.—Thirty subscribers have been secured for the farmers' telephone line from Byron to Knightsen, and more are expected. Work on that branch has been begun and will cover about twenty miles of territory. The company has been organized under the name of Byron Farmers' Telephone Company.

San Luis Obispo, Cal.—New Huasnan Oil Company has been granted the right to construct a private telephone line on the outer edge of the county road from a point near the Pacific Coast depot in Arroyo Grande to the Porter ranch on the Huasna.

Lodi, Cal.—Some farmers along the Lockeford road have organized to put in a co-operative telephone line to connect with the Lodi system. Construction work is now being pushed.

TRANSPORTATION.

Glendora, Cal.—Active construction work on the extension of the Pacific Electric Railroad from Monrovia to Glendora by way of Azusa, has begun.

Guadalajara, Mex.—The city council of Tepic has granted to Leopoldo Villareal, an engineer of Mexico City, a concession for a street railway system in Tepic.

San Diego, Cal.—Extensive improvements are being made at the power house of the San Diego Electric Railway Company, in preparation for service on the lines building and contemplated and to provide power in case of a breakdown. Two steam turbine units have been ordered and two new boilers will be added. The company expects to put in feeder stations some distance from the present power house.

Los Angeles, Cal.—An extension of 9,000 feet of the Los Angeles Railway's Pico Heights line is contemplated in an application for a franchise made by Robt. Marsh & Co., to the board of supervisors.

Washington, D. C.—The proposed extension of the Tacoma Mines Ry. has been financed in New York and 16 miles additional track will be laid during the coming summer.

Washtucna, Wash.—Work has been commenced by Winters, Parsons & Boomer on a 2,400-foot tunnel through Devil's Canyon, south of Kahlotus on the Seattle & Portland project.

WATERWORKS.

San Francisco, Cal.—The report is current that the Spring Valley Water Company will submit a proposition to sell its plant in this city to the municipality and furnish a Sierra water supply for a stipulated monthly payment. No bonds are to be issued, but the water company is to be paid out of the monthly receipts of the city from consumers. The proposition includes the turning over to the city of all the mains, pipes and reservoirs of the company within the city limits. The water is to be delivered at the boundary line. While the scheme will involve the repairing by the city of all the dilapidated pipe lines of the company now laid in the city streets, the representatives of that corporation hope to be able to present a scheme so attractive that it will receive the approval of the public. It is claimed by those interested that under the plan to be proposed consumers, both domestic and municipal, may be supplied with water at a much less cost than at present, and yet leave a surplus with which to liquidate the principal of the indebtedness and interest by substantial monthly payments.

Winnemucca, Nev.—Tonopah and eastern capitalists are planning to work the rich placer deposits in American Canyon, 45 miles south of here, by collecting the waters of the different creeks on the eastern slope of the Humboldt slope and conveying the water in big pipes to the rich placer beds. The plans involve a big expenditure of money and embrace the purchase of water rights and a number of farms on the eastern slope of the range.

San Francisco, Cal.—Preliminary work on the plans for the proposed auxiliary system for protection against fire has been begun by City Engineer Woodward and Chief Shaughnessy, of the fire department, assisted by Civil Engineer T. W. Ransom and Superintendent of Engines, Gerter. The plans provide for three pumping stations on the water front by which salt water can be forced at high pressure through pipes laid in the down-town section and a complete system of cisterns installed throughout the city. City Engineer Woodward and Chief Shaughnessy announce that they will rush the preparation of data for submission to the Supervisors in order that the necessary ordinance to authorize the submission of the bond-issue feature of the scheme to a vote of the people may not be delayed.

Magdalena, N. M.—There is now a prospect of two water companies putting in a water system for this town.

San Francisco.—The Visitacion Water Company has filed a petition in the Superior Court for a judgment of dissolution. This action was decided upon at a meeting of the stockholders held January 3d. The capital stock of the corporation, which was incorporated in 1882, is $1,000,000. The directors are: D. B. Hinkley, D. H. Farquharson, C. D. Farquharson, W. A. Magee, D. E. Hayes and W. S. Downing.

OIL.

Bakersfield, Cal.—Col. Timothy Spellacy has arrived in this city from San Francisco, where he has been trying to effect an agreement between the Midway producers and the Standard Oil Company. The Standard was to take 3,500 barrels of oil at 30 cents, and to construct a pipe line into that district. Col. Spellacy announces that the deal is off, the Standard refusing to go higher than 25 cents. Nevertheless, the Standard is still surveying for the proposed pipe line. The Associated Oil Company has expressed its willingness to negotiate with the West Side producers. It is said that the Associated has made the producers an offer, and agrees to have a pipe line to Midway in the course of four months.